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Excessive Daytime Sleepiness: A 1-Year Study in an Unselected Inpatient Population

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Summary: A prospective epidemiological investigation of excessive daytime sleepiness (EDS) was carried out in an unselected inpatient population admitted to a general hospital during a 1-year period. The study comprised 2518 patients, 1347 female and 1171 male, aged 6–92 years (mean, 55.2). On the basis of histories and clinical and polysomnographic data, EDS was found in 28 cases (1.11%). Of these, 25 (0.99%; 18 female and 7 male; mean age, 61.3) had sleep apnea syndromes (SAS) with predominantly obstructive apnea. Two patients (0.07%; one female and one male; mean age, 65.5) had idiopathic CNS hypersomnia, and one male patient (0.03%) aged 48 years had a combination of narcolepsy and SAS. Differences and agreements of our findings with previous literature data are discussed. The present study shows that in an unselected inpatient population, EDS is a relatively common sleep disorder, usually found in mild to moderate forms. Because it is not severe, it disturbs only relatively domestic activities of elderly retired patients or others who do not work outside the home, and is often masked by other troubles. For these reasons, EDS in the aging population may pass unnoticed in epidemiological studies based only on data from sleep disorder centers. **Key Words:** Excessive daytime sleepiness—Sleep apnea syndromes—Epidemiology of excessive daytime sleepiness—Inpatient population.

The lack of adequate epidemiological information is an important impediment to progress in the identification of etiological factors for sleep disorders characterized by excessive daytime sleepiness (EDS).

Of the group of EDS disorders, only narcolepsy has been adequately investigated from the epidemiological standpoint. In their studies on narcolepsy in European and American populations, Bruhova and Roth (1) and Dement et al. (2) reported prevalences of 0.02 and 0.09%. Kessler et al. (3) approximated the prevalence of narcolepsy in the general U.S.A. population to be 0.04%.

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The prevalence of sleep apnea syndromes (SAS) in the general population has never been determined. Two recent and comprehensive reviews on SAS (4,5) give no epidemiological data. In any case, EDS is a relatively frequent subjective complaint, as has been reported by Bixler et al. (6) and Lavie (7).

We thought that an indirect but reliable estimate of the true prevalence of EDS in the general Italian population could be obtained from a prospective clinical-polysomnographic investigation of an unselected inpatient population in a general hospital.

METHODS

The prospective epidemiological investigation was carried out on all patients consecutively admitted to the S. Raffaele Hospital in Milan, Lombardy, for 1 year. The hospital serves mainly a metropolitan area that includes the city and the eastern part of the Milan suburbs. Divisions of general medicine and general surgery and orthopedic departments of the medical school of Milan University are located in the hospital. Patients with psychiatric or neurologic disorders and patients admitted because of sleep disorders were excluded from the study. All patients gave informed consent for the interview and possible further investigations.

A sleep questionnaire was given to all patients upon admission. It was based on our experience in the laboratory and consisted of 27 items grouped into 6 sections: demographic data, familial and personal history, sleep habits, complaints related to EDS syndromes, complaints related to other sleep disorders, and drug use. The questionnaire was administered by an expert interviewer and most questions could be answered by "yes" or "no" or with a number. Every patient was rated with the "Stanford Sleepiness Scale" (SSS) three times during the first week of hospitalization. Additional information on the sleep habits of the patients was obtained from relatives or the ward staff.

All adult patients sleeping more than 8 h out of 24 and/or taking more than one nap during the day were selected as suspect for EDS. In Italy, one nap lasting less than 1 h after lunch is considered normal.

All selected subjects were further investigated by means of neurological examination, routine EEG, polysomnography, and other suitable procedures. Polygraphic recordings of 1 night's sleep and of at least two naps were always obtained from these patients 1 week after withdrawal of any psychoactive drugs and adaptation to the laboratory environment. The standard polygraphic control included EEG (six channels), mylohyoid electromyogram (EMG), electrocardiogram (ECG), and electrooculogram (EOG). Respiratory effort was monitored by abdominal and thoracic strain-gauges and respiratory airflow by nasal and buccal thermistors. EMG activity of two intercostal muscles was monitored in most patients.

RESULTS

In 1 year, 2518 patients, 1347 females (53.5%) and 1171 males (46.5%), aged 6–92 years (mean, 55.2), were investigated upon first admission to S. Raffaele

Hospital. These patients were admitted to the medical (1209), surgical (757), and orthopedic (552) wards because of problems apparently unrelated to EDS.

On the basis of history from the questionnaire, the SSS, and clinical data, 87 patients (3.4%) were examined further by means of polysomnography and other diagnostic procedures.

EDS was found in 28 patients (1.11%), 9 men and 19 women. Of these, 25 (0.99%; 7 men and 18 women) had SAS with predominantly obstructive apnea. Two patients (0.07%; one man and one woman) had idiopathic CNS hypersomnia, while one male patient (0.03%) presented a combination of narcolepsy and SAS with predominantly obstructive apnea.

The remaining 59 patients, 20 men and 39 women, aged 35–74 years (mean, 59), had normal polysomnographic patterns and showed no definite sleep disorders. This group was not significantly different from the EDS group in age, sex, occupational status, weight, or any other features.

Figure 1 shows the results obtained at the different stages of the study.

General features of EDS patients

The 28 EDS patients were 16–78 years of age (mean ± SD, 60.3 ± 14.2). Table 1 shows the age distribution by decades of inpatient and EDS groups and of the general Lombard population.

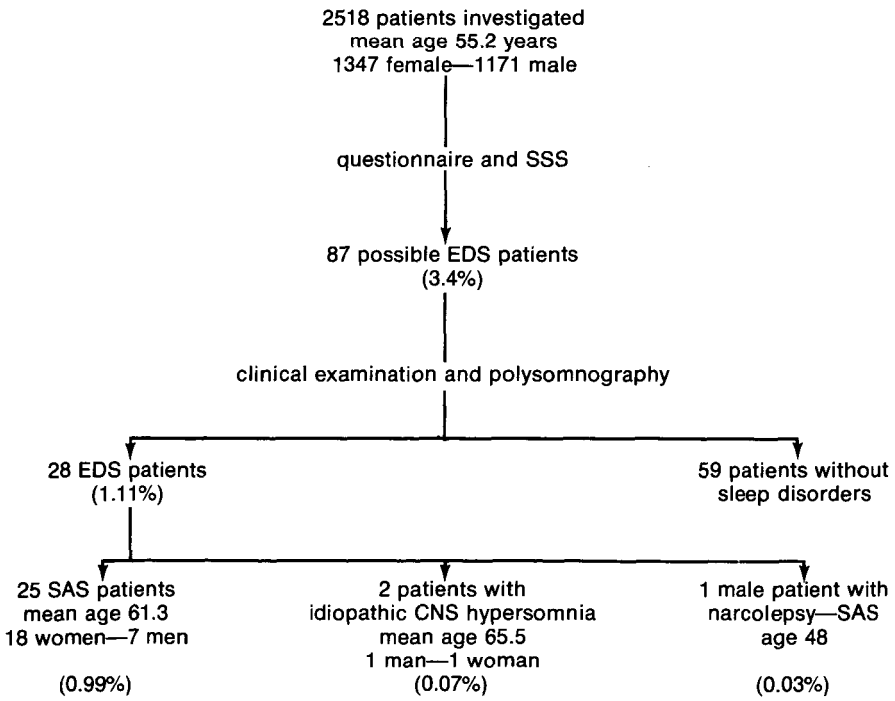

FIG. 1. Results at different stages of the study.

TABLE 1. *Age distribution of inpatient and EDS groups and of the Lombard population*

Age decade	Inpatient group				EDS group				% of age decades in general Lombard population[a]
	n	M	F	%	n	M	F	%	
1	14	9	5	0.5	—	—	—	—	16.0
2	144	76	68	5.8	1	—	1	0.70	13.9
3	186	99	87	7.6	—	—	—	—	15.1
4	291	136	155	11.5	4	2	2	1.37	13.5
5	403	200	203	16.0	5	2	3	1.24	14.0
6	510	242	268	20.2	8	3	5	1.56	10.8
7	505	225	280	20.0	9	1	8	1.78	9.7
8–9–10	465	184	281	18.4	1	1	—	0.21	7.0
Total	2518	1171	1347	100.0	28	9	19		100.0

M, Male; F, female.

[a] Data from Annuario Statistico Italiano. Roma: Istituto Centrale di Statistica, 1978.

Thirteen patients (46.5%) were retired, 12 (42.8%) were homemakers, two (7.2%) were employees, and another (3.5%) was a workman.

Only two patients (7.2%) were of normal weight according to the tables of the Society of Actuaries (1959) corrected for age, sex, and height. Fourteen patients (50%) were 20–50%, nine (32.1%) were 50–100%, and three (10.7%) were 100–150% overweight.

The EDS patients had been admitted to the hospital for the following diseases: diabetes mellitus (seven cases: 25%); hypertension (six cases: 21.4%); ischemic heart disease (three cases: 10.7%); obesity, hypothyroidism, or degenerative arthritis (two cases each: 7.1%); and microcytic anemia, distal thrombophlebitis, Prader-Willi syndrome, prostatic adenoma, diabetes insipidus, or gallstones (one case each: 3.5%). The youngest SAS patient (16 years old) had Prader-Willi syndrome and hypertrophic tonsils.

All patients were normal in the neurological examination.

EEG and polysomnographic features of EDS patients

Waking EEGs were normal in 20 patients (71.4%). Borderline EEG patterns, i.e., diffuse and mild slowing of cerebral rhythms, were found in six patients (21.4%). Two others (7.2%) had intermittent localized theta-delta activity, apparently related only to long-lasting headache clusters.

We defined apnea as any cessation of airflow at the level of the nostrils and mouth lasting for at least 10 s (4). To quantify the severity of the respiratory abnormality, we used the "Apnea Index" (AI), i.e., the number of apnea episodes per sleep-hour (4). SAS was diagnosed when the AI was greater than 10 (4). The AI for our patients ranged from 12 to 21, except in the Prader-Willi patient who scored 60. The duration of apnea ranged from 15 to 130 s; the uncommon central or mixed apnea observed in our patients rarely exceeded 20 s. No significant correlation was found between AI and mean duration of apnea, weight, age, or subjective complaints.

All SAS patients usually slept more than 10 h and 45 min per 24 h (SSS) and showed typical polysomnographic patterns with signs of arousal at the end of apnea and variable reductions of deep non-rapid eye movement (NREM) stages during the night (stage III–IV always less than 12.5%).

The two hypersomniac patients slept 12–20 h per 24, but sleep architecture was normal. The narcoleptic patient had typical sleep-onset REM periods.

Clinical features of EDS patients

Four patients (14.3%) had medical conditions predisposing to SAS (i.e., hypothyroidism or chronic obstructive bronchitis). In seven cases (25%) obstructive anatomical conditions of the upper airways were evident: hypertrophic tonsils in five cases and goiter or deviation of the nasal septum in one case each.

Seven patients (25%) had essential hypertension under chronic treatment: three patients (10%) had ischemic heart disease. Eight patients (28.5%) were diabetics: two insulin dependent and six insulin independent. In none of the diabetic patients could EDS ever be related to complications of the disease.

Accurate histories of EDS patients never showed EDS or "sudden infant death syndrome" in relatives.

EDS never caused severe accidents, but it did limit social relations and everyday activities of all patients.

Only rarely was it possible to state exactly the duration of EDS. It ranged between 2 and 20 years.

All patients snored to variable degrees. Fifteen patients (53.5%) complained of morning headache and fatigue. Seven patients (25%) showed irritability and marked mood variability. Six patients (21.4%) were orthopnics. Hyperhidrosis was striking in seven patients (25%), particularly during the night. Two of the nine men (22.2%) complained of impotence.

The patient with narcolepsy-SAS frequently experienced sleep attacks, hypnagogic hallucinations, and sleep paralysis, but only rarely cataplectic episodes.

The two patients with idiopathic CNS hypersomnia did not have sudden sleep attacks, but had severe drowsiness forcing repeated naps.

Six patients (21.4%) occasionally had nocturnal enuresis; four patients (14.2%) showed bruxism; one had restless legs syndrome; and one had somnambulism (3.5%).

Table 2 shows the main pathological conditions associated with EDS in our population.

DISCUSSION

A prospective epidemiological investigation of EDS was carried out in an unselected inpatient population admitted to a general hospital during a 1-year period.

Of the 2518 patients who entered the study, none entered the hospital because of sleep disorders. EDS was detected in 28 cases (1.11%). Twenty-five patients (0.99%) had SAS with predominantly obstructive apnea. Two patients (0.07%) had idiopathic CNS hypersomnia, and one patient (0.03%) showed a combination of narcolepsy and SAS with predominantly obstructive apnea.

Recently, Bixler et al. (6) described subjective EDS in 7.1% of subjects from the

TABLE 2. *Main pathological conditions associated with EDS in 28 patients*

Condition	Number of cases	Percentage
Snoring	28	100
Overweight	26	92.8
Morning headache and fatigue	15	53.5
Parasomnias	12	42.8
Diabetes mellitus	8	28.5
Hypertension	7	25.0
Irritability and mood variability	7	25.0
Anatomical obstructions of upper airways	7	25.0
Hyperhidrosis	7	25.0
Orthopnea	6	21.4
Medical conditions predisposing to EDS (other than obesity)	4	14.2
Ischemic heart disease	3	10.7

Los Angeles metropolitan area. Unfortunately, these results cannot easily be compared with ours because in their study there was no attempt to validate the complaint objectively. Furthermore, in the Bixler et al. study, EDS was significantly associated with emotional problems and with the use of mental health facilities. Although the first stage of our study, based on the questionnaire and the SSS, did give a similar percentage (3.4%), in most cases polysomnography did not validate the subjective complaint.

Lavie (7) interviewed 1500 workers, of whom 7.8% reported EDS. Preliminary results of polysomnography of these subjects demonstrated that SAS affects some 1.5% of the adult industrial workers in Israel. These figures agree with both our data and those of Bixler.

The prevalences of narcolepsy and idiopathic CNS hypersomnia observed in our population were very similar to those reported earlier by Bruhova and Roth (1), Dement et al. (2), and Kessler et al. (3).

From the American and British literature, it would seem that in those populations SAS occurs more rarely than narcolepsy. For example, Parkes (8) reported one case of SAS in a sample of 184 EDS patients. Guilleminault and Dement (9) observed SAS in only approximately 18% of 235 patients, whereas narcolepsy was observed in 61% of their patients.

These data are at striking variance with our own findings, which agree with those commonly obtained in Italian sleep laboratories. In the Italian experience, SAS is the most frequent cause of EDS, which is only rarely related to narcolepsy or idiopathic CNS hypersomnia. These contrasting data might be explained by genetic, constitutional, and cultural (i.e., eating habits) differences between the populations studied. For example, Mediterranean populations might be prone to SAS because of their bulky body forms and high dietary intake of carbohydrates, whereas English-speaking populations might be prone to narcolepsy because of their genetic patterns. It must be emphasized that very recent case series from the Veterans Administration Sleep Disorders Centers (10,11) report SAS/narcolepsy ratios more similar to ours.

The preponderance of women in our EDS population was unexpected. The female/male ratio was 19/9 for the entire EDS group and 18/7 for the SAS group. This is at variance with the male preponderance in SAS in the literature (4,5) and in the case series of our sleep disorders center (48 men and only 3 women with SAS). This cannot be completely explained by the fact that in our population females outnumbered males (female/male ratio = 1.15). Men were poorly represented in our SAS population probably because obesity and/or obstructive conditions of upper airways cause earlier and more severe SAS, interfering heavily with work activities. Therefore, men usually seek medical advice for their sleep disorders, and hence were excluded from our study. On the other hand, recent studies (12) show that postmenopausal women (16 of 19 in our sample) resemble men in incidence of breathing disorders during sleep and nocturnal oxygen desaturation. Furthermore, all our SAS female patients were obese and consequently more prone to develop SAS.

Another unexpected finding in our study was that patients always underestimated their sleep disorder and never sought a doctor's advice. Our rather elderly

patients probably were relatively unaware of their sleep disorder because it caused only moderate disturbance of their domestic activities or was masked by other diseases. Obviously, relative unawareness of EDS in elderly and retired patients will interfere with correct evaluation of EDS prevalence in the general population, unless it is looked for specifically.

It was not unexpected that the SAS patients were older than the population as a whole (61.3 vs 55.2 years), since increasing age is correlated with sleep-disordered breathing (13,14) and with oxygen desaturation in both men and postmenopausal women (12,15). These conditions lead to clinical SAS in only a small proportion of the population for unclear reasons, one of which may be the obesity present in all our patients.

"Classic" pathological conditions predisposing to SAS (obesity, snoring, anatomical obstructions of the upper airways) or associated with SAS (orthopnea, morning headache and fatigue, irritability and mood variability, impotence, hyperhidrosis) were frequently observed in our patients. In addition, cardiovascular diseases and hypertension were frequently related to SAS (5).

The significant correlation between SAS and diabetes mellitus in our patients might be explained by the fact that the diabetes was usually insulin independent (six of eight patients) and always obesity related.

We found the frequent association of parasomnias, especially enuresis and bruxism, with EDS syndromes quite interesting.

In conclusion, our study showed that in an unselected inpatient population, EDS was a relatively common sleep disorder, usually present in a mild to moderate form and therefore generally underestimated by the patients. The inpatient population was significantly different from the population at large from several standpoints, one of which was the age distribution. Table 1 shows that our patients represented the general population of Lombardy for only two age decades: the fourth and the fifth. EDS patients referred to sleep disorder centers or to neurology wards specifically for sleep disorders, which our experimental design excluded, usually are in these age ranges. For these reasons, it can be argued that in the general population, the prevalence of EDS should not be lower than we found in our unselected inpatient population, at least for those in the fourth and fifth decades of life.

Additional epidemiological studies in different populations and different experimental designs are needed to increase our knowledge about this not uncommon and underestimated problem.

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